

BEFORE THE PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

----- In the Matter of -----)	
)	
PUBLIC UTILITIES COMMISSION)	DOCKET NO. 2018-0165
)	
Instituting a Proceeding)	
To Investigate Integrated)	
Grid Planning.)	
_____)	

ORDER NO. 38482

APPROVING WITH MODIFICATIONS
HAWAIIAN ELECTRIC'S GRID NEEDS ASSESSMENT

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By this Order, the Public Utilities Commission ("Commission") approves with modifications the Grid Needs Assessment and Solution Evaluation Methodology ("Grid Needs Assessment Methodology") filed by HAWAIIAN ELECTRIC COMPANY, INC., HAWAII ELECTRIC LIGHT COMPANY, INC., and MAUI ELECTRIC COMPANY, LIMITED (collectively, "Hawaiian Electric")¹ on November 5, 2021.²

¹The Parties to this proceeding are Hawaiian Electric, the DIVISION OF CONSUMER ADVOCACY ("Consumer Advocate"), an ex officio party, and the Intervenors: (1) LIFE OF THE LAND ("LOL"); (2) ENERGY ISLAND; (3) COUNTY OF HAWAII ("County"); (4) HAWAII PV COALITION ("HPVC"); (5) HAWAII SOLAR ENERGY ASSOCIATION ("HSEA"); (6) PROGRESSION HAWAII OFFSHORE WIND, LLC ("Progression"); (7) ULUPONO INITIATIVE, LLC ("Ulupono"); and (8) BLUE PLANET FOUNDATION ("Blue Planet").

²"The Hawaiian Electric Companies' Grid Needs Assessment Methodology Review Point, Books 1-2," filed on November 5, 2021 ("Grid Needs Assessment Methodology").

I.

BACKGROUND

On July 12, 2018, the Commission opened this docket to investigate an Integrated Grid Planning ("IGP") process for Hawaiian Electric.³ As IGP progressed, the Commission issued three orders providing guidance.⁴

On November 5, 2021, Hawaiian Electric filed its Grid Needs Assessment Methodology.

On November 30, 2021, the Commission established the procedural schedule to review the Grid Needs Assessment Methodology.⁵

On December 16, 2021, the Commission granted Hawaiian Electric's request to extend the procedural schedule set forth in Order No. 38093.⁶

³See Order No. 35569, "Instituting a Proceeding to Investigate Integrated Grid Planning," filed on July 12, 2018 ("Order No. 35569").

⁴See Order No. 36218, "Accepting the IGP Workplan and Providing Guidance," filed on March 14, 2019; Order No. 36725, "Providing Guidance," filed on November 4, 2019; Order No. 37419, "Providing Guidance," filed on November 5, 2020.

⁵See Order No. 38093, "Establishing a Procedural Schedule for the Draft Grid Needs Assessment Methodology," filed on November 30, 2021 ("Order No. 38093").

⁶See Order No. 38126, "Granting Hawaiian Electric's Request for Extension of Time," filed on December 16, 2021.

On December 17, 2021: (1) Ulupono filed comments;⁷ and (2) Blue Planet, HPVC, and HSEA (together, "Joint Parties") filed joint comments on the Grid Needs Assessment Methodology.⁸

On December 20, 2021: (1) Progression filed comments;⁹ and (2) the Consumer Advocate filed comments.¹⁰

On December 21, 2021, County of Hawaii filed comments.¹¹

On January 10, 2022, Hawaiian Electric filed reply comments.¹²

⁷"Comments of Ulupono Initiative LLC on the Hawaiian Electric Companies Grid Needs Assessment Methodology and Solution Evaluation Methodology Filed November 5, 2021; and Certificate of Service," filed on December 17, 2021 ("Ulupono Comments").

⁸"The Joint Parties' Comments on the Hawaiian Electric Companies' Grid Needs Assessment Methodology and Solution Evaluation Methodology Filed November 5, 2021; and Certificate of Service," filed on December 17, 2021 ("Joint Comments").

⁹"Progression Hawaii Offshore Wind, LLC's Comments on Hawaiian Electric Companies' Grid Needs Assessment Methodology; and Certificate of Service," filed on December 20, 2021 ("Progression Comments").

¹⁰"Division of Consumer Advocacy's Comments on the Hawaiian Electric Companies' Draft Grid Needs Assessment Methodology," filed on December 20, 2021 ("Consumer Advocate Comments").

¹¹"County of Hawaii's Comments on Hawaiian Electric Companies Grid Needs Assessment Methodology and Solution Evaluation Methodology Filed November 5, 2021; and Certificate of Service," filed on December 21, 2021 ("County Comments").

¹²"Hawaiian Electric Companies' Reply to Party Comments; and Certificate of Service," filed on January 10, 2022 ("Hawaiian Electric Reply Comments").

On March 10, 2022, Hawaiian Electric filed updated IGP timelines and interrelationships with other procurements.¹³

II.

POSITIONS OF THE PARTIES

A.

County of Hawaii

The County appreciates the significant work that has gone into Grid Needs Assessment Methodology, and that Hawaiian Electric has incorporated several of its comments.¹⁴ The County offers recommendations on Hawaiian Electric's Renewable Energy Zones ("REZ") study, including that it should: (1) strongly consider system reliability in the selection of the projected generation technologies;¹⁵ (2) explicitly describe potential generation shortfalls and how future REZ iterations will account for the uncertainty of renewable generation sources like solar PV and wind turbines; (3) consider and explicitly describe potential generation technologies that may operate with diverse sources of

¹³Letter From: R. Dayhuff Matsushima & M. Asano To: Commission Re: "Docket No. 2017-0352 - To Institute a Proceeding Relating to a Competitive Bidding Process to Acquire Dispatchable and Renewable Generation, Docket No. 2018-0165 - Instituting a Proceeding to Investigate Integrated Grid Planning, Development of Stage 3 RFPs for Oahu and Maui," filed on March 10, 2022.

¹⁴See County Comments at 2.

¹⁵See County Comments at 2-3.

energy/fuel that can supplement renewables and describe how they will fit into further REZ iterations; and (4) consider and explicitly state how non-transmission alternatives ("NTAs") will play a role in future system topologies, operations, and market mechanisms, including whether, and if so, how, NTAs will be included in future iterations of REZ analyses.¹⁶

The County also recommends that Hawaiian Electric add an executive summary section in each exhibit of the methodology to summarize the findings from the analysis and the future actionable steps the utility wishes to conduct based on the findings, and do so in language crafted to be non-technical and easily interpreted by all stakeholders including community members without a technical background of power engineering.¹⁷

B.

Progression

Progression does not believe any areas of concern or pending issues with the Grid Needs Assessment Methodology need to be resolved before Hawaiian Electric proceeds with this IGP cycle.¹⁸ Accordingly, Progression does not seek any specific

¹⁶See County Comments at 2-4.

¹⁷See County Comments at 4.

¹⁸See Progression Comments at 2.

modifications at this time.¹⁹ Progression asserts that now is the time to move forward with IGP with no further delay.²⁰

C.

Joint Parties

The Joint Parties raise concerns with and offer suggestions to clarify and improve the Grid Needs Assessment Methodology. Specifically, the Joint Parties believe Hawaiian Electric should: (1) seek and incorporate stakeholder input early and regularly during the modeling process; (2) examine the value of energy reserve margin ("ERM") modeling for an alternative grid structure with high penetrations of distributed energy resources ("DERs") and minimal reliance on biofuels; (3) model electric vehicle ("EV") uptake with and without managed charging to better inform EV programs and pricing; (4) maximize and accelerate fossil unit retirements; (5) plan transmission upgrades in a cost-effective manner while being mindful of community concerns around siting; and (6) improve long-term planning for grid upgrades associated with DERs.²¹ Nevertheless, the Joint Parties state that it "is critical that Hawaiian Electric

¹⁹See Progression Comments at 2.

²⁰See Progression Comments at 3.

²¹See Joint Comments at 2.

promptly conduct an initial run of the RESOLVE model and begin engaging with stakeholders on any adjustments that may be necessary.”²² The Joint Parties offer more specific suggestions as follows.

Manual adjustments and modeling iterations.

According to the Joint Parties, it is not clear whether, when, and how Hawaiian Electric will vet manual changes it makes to its models with stakeholders, and believe that Hawaiian Electric should clarify the nature, scope, process, and timing for making manual changes, and ensure that stakeholder feedback is considered before any final decisions are made.²³ The Joint Parties assert that, at a minimum, Hawaiian Electric should inform and consult with stakeholders: (1) after the initial scenario analysis is run in RESOLVE, including for all scenarios and sensitivities; (2) in any iterations or adjustments to the scenarios or sensitivities; (3) in developing preferred grid needs portfolios; and (4) in discussions around solution sourcing, i.e., programs, pricing, and procurements.²⁴ The Joint Parties take no position

²²Joint Comments at 2.

²³See Joint Comments at 2-3.

²⁴See Joint Comments at 3.

on various proposed methodologies for the ERM, but believe that an ERM may not be well suited to Hawaii.²⁵

Program Evaluation. The Joint Parties suggest that EV charging layers are unlikely to provide useful information for EV charging programs or pricing, unless multiple EV adoption scenarios are modeled, both with and without managed charging.²⁶

Fossil Fuel Retirement. The Joint Parties are concerned that Hawaiian Electric still has not addressed stakeholder concerns regarding its proposed fossil unit retirement plan, has failed to justify its proposed retirement plan, and has declined to allow RESOLVE to optimize a retirement schedule.²⁷

REZ. The Joint Parties are concerned that Hawaiian Electric's proposed REZ approach could exacerbate energy equity concerns related to project siting.²⁸

Hosting Capacity. The Joint Parties are concerned that Hawaiian Electric's hosting capacity assessment does not clarify long-term needs or support approaches to streamline and limit upgrade costs.²⁹ The Joint Parties believe that Hawaiian Electric

²⁵See Joint Comments at 3.

²⁶See Joint Comments at 3-4.

²⁷See Joint Comments at 4.

²⁸See Joint Comments at 4-5.

²⁹See Joint Comments at 5.

should collect AMI and field data and incorporate it into this analysis, and also clarify whether non-wires solutions are, or will, be considered as part of this analysis.³⁰

D.

Uluono

Uluono lists 27 areas where it provided feedback to Hawaiian Electric and explains Hawaiian Electric's response, including whether it thinks Hawaiian Electric's response is satisfactory.³¹ Uluono finds most of Hawaiian Electric's responses to be satisfactory, but raises concerns with individual responses as follows.

Assume batteries and renewables can provide virtual inertia. Uluono concludes that Hawaiian Electric's response is satisfactory, assuming that inverters can provide virtual inertia during the system security simulations, as Hawaiian Electric stated in response to party comments.³²

Regulating reserve, fast frequency response ("FFR"), and inertia requirements. Uluono argues that omitting regulating reserves from RESOLVE could potentially bias the plan toward too

³⁰See Joint Comments at 5.

³¹See Uluono Comments, Attachment 1, at 1-17.

³²See Uluono Comments, Attachment 1, at 1.

little generating capacity in the medium time frame; however, Ulupono acknowledges that this might not be a severe issue in early years because the system already has adequate capacity to provide reserves or after 2045 because the resources used for diurnal balancing in a 100% renewable system should be able to provide ample spinning reserves.³³ Ulupono suggests that if Hawaiian Electric finds that the system is short of regulating reserves or inertia in the post-RESOLVE reliability assessment, then it should apply its operating reserve rule in RESOLVE so that it can optimize the selection of resources to meet and/or avoid this need.³⁴

Ulupono is concerned that if Hawaiian Electric omits regulating reserve requirements from RESOLVE and then uses heuristic methods to fix the plan after the fact, it risks selecting the wrong mix of resources.³⁵ Ulupono suggests that if RESOLVE cannot model regulating reserves, Hawaiian Electric could consider extending RESOLVE to do so or adopt another model, i.e., Switch, which can.³⁶

³³See Ulupono Comments, Attachment 1, at 1-2.

³⁴See Ulupono Comments, Attachment 1, at 2.

³⁵See Ulupono Comments, Attachment 1, at 2.

³⁶See Ulupono Comments, Attachment 1, at 2.

Uluono expresses concern that Hawaiian Electric's 3-sigma rule lacks a clear statistical rationale, and believes Hawaiian Electric should explain why it chose this method instead of the "PSIP" rule, and/or compare its effectiveness to the PSIP rule.³⁷ Uluono submits that this method is workable for now, but recommends further analysis to fine-tune the sigma multiplier and to assess whether the PSIP method, n-sigma or a percentile-based method gives the best combination of high reliability and low reserve requirements.³⁸

N-1 Outage Criteria. Uluono states that using a fixed contingency reserve instead of an N-1 rule could bias RESOLVE in favor of large individual generators, because the fixed reserve margin masks the fact that large generators raise the reserve requirement for the system during all the hours when they are online.³⁹ Uluono suggests that this may be mitigated in high-renewable years, when resources used for diurnal balancing (mainly batteries and demand response) can also provide ample reserves most of the time.⁴⁰ Uluono offers ways to address this, including: (1) adding an N-1 spinning reserve requirement to

³⁷See Uluono Comments, Attachment 1, at 3.

³⁸See Uluono Comments, Attachment 1, at 3.

³⁹See Uluono Comments, Attachment 1, at 3.

⁴⁰See Uluono Comments, Attachment 1, at 3-4.

RESOLVE; (2) by using the Switch model, which has this ability; or (3) running an alternative scenario in RESOLVE with a smaller fixed reserve margin and no option to build or run large plants in later years, and comparing the cost of this low-reserves scenario to the main scenario.⁴¹ Ulupono concludes Hawaiian Electric's proposed approach is satisfactory for now, so long as Hawaiian Electric does not use this modeling to justify investment in any large generators, due to potential bias.⁴²

Hourly Dependable Capacity ("HDC") and ERM.

Ulupono contends that Hawaiian Electric's proposed HDC approach introduces a significant bias in favor of thermal capacity in the RESOLVE modeling, which should preclude Hawaiian Electric from using RESOLVE results to justify investment in new thermal capacity.⁴³ Ulupono explains that adopting a near zero HDC for renewable resources significantly understates their contribution to system reliability, and adopting an HDC of 100% for thermal plants overstates their contribution to reliability.⁴⁴

Ulupono maintains that Hawaiian Electric's current ERM framework ensures that the required margin will be provided only

⁴¹See Ulupono Comments, Attachment 1, at 4.

⁴²See Ulupono Comments, Attachment 1, at 4.

⁴³See Ulupono Comments, Attachment 1, at 5.

⁴⁴See Ulupono Comments, Attachment 1, at 5-6.

by building or retaining thermal capacity (which gets 100% credit toward ERM) and not renewable capacity (which gets nearly 0% credit toward ERM).⁴⁵ Ulupono is concerned that Hawaiian Electric's choice to use extremely low HDCs for renewables and 100% HDCs for thermal plants introduces a significant bias in RESOLVE in favor of thermal capacity.⁴⁶ Ulupono proposes two potential options to ensure that RESOLVE selects resources in an unbiased manner to achieve generation adequacy: (1) meet ERM in RESOLVE with Hourly Expected Capacity ("HEC") instead of HDC; or (2) convert ERM into a single capacity target (e.g., peak load + ERM) and credit each resource toward that target based on its effective load carrying capability ("ELCC").⁴⁷ Ulupono states that it is important not to make long-term plans based on the current HDC method, since it is known to be biased.⁴⁸

ERM. Ulupono offers an option to achieve generation adequacy in an unbiased manner by crediting each resource toward the hourly ERM based on its expected output during that hour.⁴⁹

⁴⁵See Ulupono Comments, Attachment 1, at 6.

⁴⁶See Ulupono Comments, Attachment 1, at 6.

⁴⁷See Ulupono Comments, Attachment 1, at 7-8. The Commission notes that while Ulupono uses the term "effective load carrying capacity," this term can be used interchangeably with the more commonly used "effective load carrying capability."

⁴⁸See Ulupono Comments, Attachment 1, at 8.

⁴⁹See Ulupono Comments, Attachment 1, at 10.

Ulupono contends that this would achieve reliability no matter which sample days are used in RESOLVE, provided the ERM is raised high enough (e.g., by iterating between RESOLVE and a reliability model and raising ERM until reliability is achieved).⁵⁰ Ulupono argues that there is no clear reason to omit the worst weather day from RESOLVE, and including it is likely to reduce the cost of the final plan, since RESOLVE can tailor the resource portfolio more precisely for these difficult conditions.⁵¹

Ulupono argues that although it is possible to proceed with the current sample days selected for RESOLVE, this choice would undermine confidence in the resulting plan.⁵² Instead, Ulupono recommends adding the worst-case weather day to RESOLVE, with an appropriately low weight (such as zero, which will drive capacity choices without otherwise affecting the model).⁵³ Ulupono submits this day can be identified by doing an initial run of RESOLVE, then running the resulting plan for 2045 in a production cost model with many years of weather data and identifying the single day with the highest operating cost (including a high penalty for unserved load), and then adding the

⁵⁰See Ulupono Comments, Attachment 1, at 10.

⁵¹See Ulupono Comments, Attachment 1, at 10-11.

⁵²See Ulupono Comments, Attachment 1, at 11.

⁵³See Ulupono Comments, Attachment 1, at 11.

worst-weather day to the RESOLVE sample set for all future modeling.⁵⁴

Calculating regulating reserve. Ulupono argues that Hawaiian Electric did not adequately address its recommendation to calculate regulating reserve using its desired percentile, instead of three standard deviations (3-sigma).⁵⁵ Ulupono asserts that wind, solar and load variations do not follow a "normal" (Gaussian) distribution, and thus applying 3-sigma to these variations will not achieve the reliability level that Hawaiian Electric may expect, and could differ sharply from 99.7%.⁵⁶ Ulupono suggests that Hawaiian Electric avoid this problem by taking the 99.7th percentile directly from its data (if available), or by bootstrapping realistic distributions.⁵⁷ Ultimately, Ulupono believes the 3-sigma assumption seems to be adequate for now, while additional analysis is done.⁵⁸

Additional concerns. Ulupono expresses concern that Hawaiian Electric has not stated that it is capping the reserve

⁵⁴See Ulupono Comments, Attachment 1, at 11.

⁵⁵See Ulupono Comments, Attachment 1, at 11.

⁵⁶See Ulupono Comments, Attachment 1, at 11-12.

⁵⁷See Ulupono Comments, Attachment 1, at 12.

⁵⁸See Ulupono Comments, Attachment 1, at 12.

requirement at the lesser of renewable output or load.⁵⁹ Ulupono requests that Hawaiian Electric verify that these caps are in place before running RESOLVE.⁶⁰ Ulupono also suggests that although uncertainty remains about the National Renewable Energy Laboratories ("NREL") resource potential study (e.g., slopes between 20-30% and U.S. Department of Defense lands), the overall budget appears to be accurate enough to proceed with the planning.⁶¹ Ulupono suggests that Hawaiian Electric should clarify how it selects representative days, and that it may be helpful to add the most difficult weather day or days to the sample set.⁶²

E.

Consumer Advocate

The Consumer Advocate maintains that IGP modeling and analysis should move forward, including RESOLVE, LoadSEER, and PLEXOS analyses, production cost simulations, and any system security analysis that can be conducted, for at least the High Load Customer Technology Adoption Bookend and Low Load

⁵⁹See Ulupono Comments, Attachment 1, at 12.

⁶⁰See Ulupono Comments, Attachment 1, at 13.

⁶¹See Ulupono Comments, Attachment 1, at 16.

⁶²See Ulupono Comments, Attachment 1, at 17.

Customer Technology Adoption Bookend.⁶³ The Consumer Advocate contends that the resulting plans should be viewed as a planning tool that does not lay out a prescriptive path that must be followed, but as an iterative and continual process that helps to inform other proceedings.⁶⁴

F.

Hawaiian Electric

Hawaiian Electric argues that the IGP process has reached a critical juncture, and advancing to the next stage will: (1) facilitate a more robust discussion by stakeholders; (2) support Commission decision making in various current and future proceedings; and (3) help to achieve key decarbonization and resilience goals in Hawaii.⁶⁵ Hawaiian Electric states that now is the time to move forward, and agrees with the Consumer Advocate's position that the intent of IGP is not to lay out a prescriptive path that must be followed, but to be an iterative and continual process that helps to inform other

⁶³See Consumer Advocate Comments at 3.

⁶⁴See Consumer Advocate Comments at 3.

⁶⁵See Hawaiian Electric Reply Comments at 5.

proceedings.⁶⁶ Hawaiian Electric also responded to specific stakeholder questions and concerns, as discussed below.

III.

DISCUSSION

A.

Summary

The Grid Needs Assessment Methodology “focuses on the overall process flow of and methodology behind the modeling and analysis, conducted in RESOLVE & PLEXOS, among other modeling tools, to derive the Grid Needs to inform solution sourcing and to evaluate or select solutions.”⁶⁷ This is consistent with what Hawaiian Electric proposed in its Updated Workplan.⁶⁸ The Commission believes that the Grid Needs Assessment Methodology fulfills these basic purposes. The Commission therefore approves the Grid Needs Assessment Methodology, with modifications related to Energy Reserve Margin and Capacity Accreditation, as discussed below. In addition, the Commission provides further direction,

⁶⁶See Hawaiian Electric Reply Comments at 5.

⁶⁷Grid Needs Assessment Methodology at 1.

⁶⁸See Letter From: K. Katsura To: Commission Re: “Docket No. 2018-0165, Instituting a Proceeding to Investigate Integrated Grid Planning, Hawaiian Electric Companies Updated Workplan,” filed on January 19, 2021 (“Updated Workplan”) at 6-8.

clarification, and guidance related to: (1) Grid Service Capability by Technology; (2) Impact of System Security Analysis on Resource Plans; (3) Regulating Reserve Criteria; (4) Energy Efficiency Supply Curves; (5) Solution Evaluation Modeling Process & Competitive Procurement Evaluations; (6) the Transmission Renewable Energy Zone Study; (7) Distribution Hosting Capacity and Grid Needs; (8) Stakeholder Engagement; and (9) the Technical Advisory Panel.

B.

Modifying Energy Reserve Margin and Capacity Accreditation

System reliability is one of the six central modeling objectives of the Grid Needs Assessment Methodology.⁶⁹ As the State comes to rely more on variable renewable energy resources and storage, Hawaiian Electric must adapt its reliability planning criteria to be suitable for an expansive set of situations that might threaten reliability.

In May 2020, Hawaiian Electric introduced the ERM as a replacement for its previous capacity planning criteria, which had

⁶⁹Grid Needs Assessment Methodology, Exhibit 1 at 3.

focused on meeting peak demand on each island.⁷⁰ According to Hawaiian Electric, the ERM planning criteria:

considers the total firm system capability that is reduced by planned maintenance and outages and increased by hourly dependable capacity ("HDC") of variable renewable resources, shifted load from energy storage resources, and interruptible load, the sum of which must be greater than the load that is increased by the ERM percentage on an hourly basis.⁷¹

Hawaiian Electric applies the ERM planning criteria during the capacity expansion step of the grid needs assessment modeling framework.⁷² Functionally, this involves modifying the hourly load shapes and resource availability profiles used as inputs in RESOLVE. The hourly load shape inputs are scaled up by the ERM target percentage (initially proposed as 30% on Oahu, Hawaii Island, and Maui and 60% on Molokai and Lanai), and the hourly solar and wind resource availability profile inputs are scaled down to reflect their HDC (initially proposed as a 3-day rolling average of each resource's hourly availability based on Hawaiian Electric's historic weather data, minus 2 standard

⁷⁰The ERM was introduced at the Solution Evaluation & Optimization Working Group meeting on May 22, 2020. https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/working_groups/solution_evaluation_and_optimization/20200522_wg_seo_meeting_presentation_slides.pdf.

⁷¹Grid Needs Assessment Methodology, Exhibit 1 at 31.

⁷²See Grid Needs Assessment Methodology, Exhibit 1 at 45.

deviations ("2-sigma") for solar PV and 1 standard deviation ("1-sigma") for wind).⁷³

The Commission commends Hawaiian Electric for recognizing the need to use modernized reliability planning criteria as the State transitions to a generation portfolio with more weather-dependent and energy-limited resources. But the Commission shares many concerns expressed by stakeholders and the TAP with Hawaiian Electric's ERM criteria, and particularly with the HDC metric used to define the hourly reliable capacity contributions from variable renewable resources. The Commission appreciates Hawaiian Electric's intent to augment the ERM- and HDC-based deterministic analyses with a stochastic resource adequacy analysis. Such an analysis is appropriate to establish the right analytical foundation for measuring the contribution to reliability provided by weather-dependent and energy-limited resources. The Commission therefore directs Hawaiian Electric to include the following elements in its stochastic assessment of resource adequacy: at least 250 stochastic outage draws, at least five historic or simulated weather years, and modeling that considers the chronological nature of dispatch decisions - to capture storage state of charge, thermal ramping constraints, minimum up and down times, and repair times, for example.

⁷³See Grid Needs Assessment Methodology, Exhibit 1 at 46, 123.

The Commission also directs Hawaiian Electric to compute, at a minimum, loss of load probability ("LOLP"), loss of load expectation ("LOLE"), loss of load hours ("LOLH"), and expected unserved energy ("EUE") for selected plan years. Hawaiian Electric should use future IGP iterations to further integrate climate change into its weather modeling.

The Commission shares some of the Parties and the TAP's concerns about Hawaiian Electric's preferred and alternative approaches to the ERM and HDC. In addition, Hawaiian Electric's proposed approaches overlook interactive effects within generation portfolios, which are essential to consider for ensuring that resource portfolios with a high proportion of weather-driven and energy-limited resources can provide reliable service across a wide range of conditions. Furthermore, the Commission believes that Hawaiian Electric's proposed minimum evaluation of the energy reserve margin criteria in the resource adequacy step of the grid needs assessment modeling framework is not sufficient because it suggests only a deterministic validation of the ERM criteria in PLEXOS and not a full reliability analysis.

The Commission agrees with the TAP that a detailed stochastic reliability analysis is appropriate now, and appreciates Hawaiian Electric's ongoing engagement with the

TAP to further refine its methodology.⁷⁴ The importance of conducting such an analysis in this iteration of the grid needs assessment is elevated given the State's ongoing transition to a portfolio of generation resources that are weather-driven and energy-limited. The Commission believes that reliability analyses that only consider a single year of load and weather data – such as Hawaiian Electric's ERM Test and economic production simulation methodologies used in its ERM analysis⁷⁵ – are insufficient for the Resource Adequacy step of the grid needs assessment modeling framework. The Commission shares the TAP's endorsement of the probabilistic methodology utilized by Telos Energy and directs Hawaiian Electric to adopt this or a similar methodology for its resource adequacy evaluation step. In so doing, the Commission further clarifies that it seeks a detailed reliability analysis including the stochastic assessment and associated elements ordered above.

ELCC is a capacity accreditation metric increasingly applied in modern reliability analyses, and which can be computed as a part of stochastic reliability assessment. In particular, ELCC is a well-established metric suitable for comparing the

⁷⁴Hawaiian Electric's Reply to PUC-HECO-IR-37, Attachment 1.

⁷⁵See Grid Needs Assessment Methodology, Exhibit 1, Appendix C, Section C.1.10 at 137.

contribution toward resource adequacy provided by a wide range of resource types, including renewable resources, energy storage, and dispatchable thermal resources subject to forced and maintenance outages. Unlike the proposed HDC metric, which derates solar and wind capacity by an arbitrary 1- or 2-sigma deduction, ELCC assigns capacity credits to variable energy resources based on their actual contribution to resource adequacy revealed by stochastic reliability analysis. Unlike HDC, ELCC captures both the synergistic and antagonistic interactions between resources in a portfolio.⁷⁶ For example, ELCC reflects the fact that adding solar and storage resources together could provide a greater reliability benefit to the system than either resource alone, and their combined contribution can change depending on the other components of the portfolio. In addition, unlike Hawaiian Electric's preferred and alternative HDC approaches, ELCC can be computed endogenously by tools such as PLEXOS as part of a stochastic resource adequacy assessment and thus requires no expert judgment to determine standard deviation

⁷⁶See Nick Schlag, Zach Ming, Arne Olson, Lakshmi Alagappan, Ben Carron, Kevin Steinberger, and Huai Jiang, Capacity and Reliability Planning in the Era of Decarbonization, Energy+Environmental Economics (August 2020), available at <https://www.ethree.com/wp-content/uploads/2020/08/E3-Practical-Application-of-ELCC.pdf>.

deductions or exceedance probability thresholds. This will support a more transparent grid needs assessment process.

Hawaiian Electric is correct that ELCC values are likely to change over time when developing resource plans over a long-term horizon.⁷⁷ As Ulupono also correctly notes, the ELCC for each resource depends on the overall system design, which will change during the planning horizon. However, this is not an insurmountable barrier to adopting an ELCC-based resource adequacy approach. Other utilities already use ELCCs in capacity adequacy analyses over long-term horizons. For example, in its 2019 IRP, Portland General Electric applied ELCCs in its capacity adequacy assessment which spans 2021 through 2050.⁷⁸ In its 2021 IRP, Puget Sound Energy computed ELCC for solar, wind, and hydroelectric capacity to determine their peak capacity credits for the 2027 and 2031 model years in its resource adequacy

⁷⁷See Response to PUC-HECO-IR-36 at 2.

⁷⁸See Portland General Electric 2019 Integrated Resource Plan, Section 4.3 Capacity Adequacy and Section 6.2.3 Capacity Value, available at <https://downloads.ctfassets.net/416ywc1lagmd/6KTPcOKF1LvXpf18xKNseh/271b9b966c913703a5126b2e7bbbc37a/2019-Integrated-Resource-Plan.pdf>.

analysis.⁷⁹ Several other western utilities have adopted ELCC in their integrated resource planning processes, as well.⁸⁰

The Commission acknowledges that Hawaiian Electric's alternative plan explicitly incorporates several of the TAP's recommendations for improving the HDC metric, and, in doing so, revises the HDC by expressing it in terms of exceedance probability rather than standard deviation deductions. Further, the Commission notes that the TAP believes that Hawaiian Electric's alternative approach is "reasonable and justified for the first IGP cycle."⁸¹ Moreover, the Parties express a strong desire to move the IGP process forward, and for Hawaiian Electric to begin engaging stakeholders to review initial modeling results.

Taking the above into account, the Commission approves Hawaiian Electric's alternative ERM planning criteria, including an exceedance-based HDC, for this round of IGP only.

⁷⁹See Puget Sound Energy 2021 Integrated Resource Plan, Chapter 7, Resource Adequacy Analysis, available at https://oohpseirp.blob.core.windows.net/media/Default/Reports/2021/Final/IRP21_Chapter%20Book%20Compressed_033021.pdf.

⁸⁰See Resource Adequacy in the Desert Southwest, Energy+Environmental Economics, at 28, Table 2-3, available at https://www.ethree.com/wp-content/uploads/2022/02/E3_SW_Resource_Adequacy_Final_Report_FINAL.pdf.

⁸¹See Response to PUC-HECO-IR-37, Attachment 1.

If Hawaiian Electric wishes to employ this methodology outside of IGP, it must seek Commission approval to do so. The Commission acknowledges that the Near-Term grid needs assessment methodologies utilized for the Stage 3 RFPs for Hawaii Island employ the exceedance-based HDC approach and shall not require the Companies to seek approval for this use case.⁸² The Commission directs Hawaiian Electric to update its Grid Needs Assessment Methodology to reflect its alternative resource adequacy methodology based on an 80th percentile HDC, incorporating the most recent feedback from the TAP, and file that updated Grid Needs Assessment Methodology by August 31, 2022.

Notwithstanding the above, the Commission, like the TAP,⁸³ believes it is appropriate to explore improvements to Hawaiian Electric's resource adequacy modeling. Specifically, the Commission would like to see methodologies that: (1) can be transparently derived from other models, such as PLEXOS, to minimize or even eliminate opaque planning judgments; (2) incorporate the interactive effects between resource types in

⁸²See Technical Advisory Panel Presentation Slides, May 4-5, 2022, available at https://www.hawaiianelectric.com/documents/clean_energy_hawaii/integrated_grid_planning/stakeholder_engagement/technical_advisory_panel/20220505_tap_presentation_materials.pdf, at 28.

⁸³Letter from M. Asano, "Updated Grid Needs Assessment for Hawaii Island," filed on April 21, 2022, in Docket No. 2017-0352, at 2.

determining their contributions to system reliability; and (3) use realistic assumptions about variable generators' availability, so as to not unfairly bias resource selection in RESOLVE towards firm thermal capacity. These characteristics will become more important as the State adds more variable renewable energy resources and storage. Like Ulupono, the Commission believes that ELCC could meet these needs.

Accordingly, the Commission instructs Hawaiian Electric to begin the process of developing an ELCC-based resource adequacy criteria for use in future rounds of IGP, and perhaps elsewhere.⁸⁴ Hawaiian Electric must develop this workplan in consultation with the TAP and the Parties. As a starting point, this workplan must explain: (1) how Hawaiian Electric intends to solicit and incorporate stakeholder feedback; (2) how long Hawaiian Electric expects the process to take; (3) how and in what dockets and other efforts Hawaiian Electric uses ERM and HDC as resource adequacy criteria; (4) how Hawaiian Electric could begin to transitioning from using ERM and HDC to ELCC, both in IGP and elsewhere; and (5) how long it would take to compute ELCC for all resource types evaluated in PLEXOS as part of Hawaiian Electric's stochastic

⁸⁴The Commission observes that Hawaiian Electric applies its planning criteria outside of IGP, including in its annual Adequacy of Supply reports and in other docketed proceedings, such as in the Kahului Power Plant Transition Plan filed in Docket No. 2021-0024.

reliability modeling in the current round of IGP so that it can begin developing expertise with ELCC now. Hawaiian Electric shall file this workplan by August 31, 2022.

The Commission understands that this process will take time, and intends to monitor this process, as well as best practices in other jurisdictions, and provide guidance as necessary.

C.

Clarifications

1.

Grid Service Capability by Technology

To run its modeling tools, Hawaiian Electric attributes certain grid service capabilities to each resource. Hawaiian Electric described these capabilities visually by color-coding resources as being capable, incapable, or partially capable or limited due to certain constraints.⁸⁵ For resources identified as partially capable of providing the service or limited due to certain constraints, Hawaiian Electric described some, but not all, of the ways that it accounts for limitations in the models.

⁸⁵See Grid Needs Assessment Methodology Exhibit 1, at 71, Table 3-7.

The Commission provided written feedback asking Hawaiian Electric to clarify how these partial capabilities were codified in the models.⁸⁶ The Grid Needs Assessment Methodology does not explicitly respond to the Commission's clarifying questions, nor does it explain how Hawaiian Electric treats the partially capable resources. For instance, in Hawaiian Electric's workbooks containing model inputs for RESOLVE, the regulating reserve and load following attribute is a binary input and this binary variable indicates that DERs cannot provide load following reserves.⁸⁷ In contrast, the Grid Needs Assessment Methodology indicates that DERs are partially capable of providing regulating reserves. In this case, it is unclear how the partial capability distinction is applied to the RESOLVE model.⁸⁸

To address this confusion, the Commission directs Hawaiian Electric to explain how it accounts for partially capable resources and resources limited due to certain constraints in all

⁸⁶Commission Staff provided feedback via email to Hawaiian Electric on September 24, 2021.

⁸⁷See Draft Oahu Inputs Workbook 1, on "reserve_resources" Sheet, the resource labeled "PV_Aggregated_DER_Battery" has a zero ("0") input for the variable labeled "can_provide_lf_reserves", available at <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/key-stakeholder-documents>.

⁸⁸See Grid Needs Assessment Methodology, Exhibit 1 at 71, Table 3-7.

the applicable modeling tools it will use in the grid needs assessment phase. Hawaiian Electric must provide this information by adding a written explanation to Section 3.5.1 in its finalized Grid Needs Assessment Methodology, which shall be submitted by August 31, 2022.

2.

Impact of System Security Analysis on Resource Plans

The System Security Analysis step serves as the final check of the resource plans and operations assumptions resulting from the capacity expansion, resource adequacy, production cost simulation and distribution analyses stages.⁸⁹ The System Security Study checks for violations in the transmission planning criteria which, if present, could require new resources, non-wires alternatives ("NWAs"), and transmission needs being added to the capacity expansion results, or could lead to generator and inverter controls adjustments or grid services and dispatch adjustments to the production cost simulations.⁹⁰

Although the System Security Analysis section clarifies the purpose of this final iteration of the grid needs assessment

⁸⁹See Grid Needs Assessment Methodology, Exhibit 1 at 42, Figure 3-1.

⁹⁰See Grid Needs Assessment Methodology, Exhibit 1 at 42, Figure 3-1.

modeling framework, Hawaiian Electric's practical approach to adjusting the resource plan for transmission planning criteria violations remains unclear. Ulupono raised the concern that using "heuristic methods to 'fix up' the plan after the fact" would risk selecting the wrong mix of resources, and emphasized the intent of the modeling tools is to co-optimize resources for multiple grid needs (i.e., energy and reserves).⁹¹ Hawaiian Electric clarified that the capacity expansion step does model regulating reserves in RESOLVE but reiterated that FFR and inertia requirements are evaluated in the system security simulations, and if stability criteria are not met, prior production simulations or capacity expansion modeling will be adjusted to address shortfalls.⁹²

The Commission shares Ulupono's concerns regarding the proper use of the optimization models in the grid needs assessment process. Furthermore, the Commission believes more explanation is needed for the magnitude of violations that would trigger an iteration in the prior modeling steps and how an addition or adjustment to the resource plan or production simulation would be sized appropriately to meet the violation.

To address these concerns, the Commission directs Hawaiian Electric to clarify the magnitude and number of violations

⁹¹Ulupono Comments, Attachment 1 at 2.

⁹²See Hawaiian Electric Reply Comments at 11-12.

that would trigger a model iteration for another step in the grid needs assessment process. Hawaiian Electric must also clarify how it will use the modeling tools to continue to optimize the resource plan after an iteration. Hawaiian Electric must provide this information by adding a written explanation to its finalized Grid Needs Assessment Methodology by August 31, 2022.

The Commission directs Hawaiian Electric to promptly communicate with the Commission and stakeholders when modeling iterations occur as a result of not meeting certain criteria from any modeling step. At a minimum, this communication must include an IGP working group meeting open to all stakeholders, such as the Stakeholder Technical Working Group ("STWG"), and be filed in writing in this docket and posted on Hawaiian Electric's IGP website. The Commission directs Hawaiian Electric to prepare methods to reincorporate virtual inertia and fast frequency response in the optimization tool used to develop resource plans in future iterations of IGP.

3.

Regulating Reserve Criteria

Hawaiian Electric detailed its methodology for establishing regulating reserve levels for each island over the

planning horizon.⁹³ Overall, the Commission is satisfied with the clarity regarding the methods used to determine regulating reserve requirements. However, Hawaiian Electric must better justify the standard deviation approach it will use to determine the regulating reserves for each island.

The TAP asked Hawaiian Electric why it selected three standard deviations (also known as "3-sigma") for determining the regulating reserve requirements. In response, Hawaiian Electric showed the minimum, maximum, and average regulation requirements at one, two, and three standard deviations and stated that it chose three standard deviations "given the small island systems with high levels of renewable penetration."⁹⁴ Although it is illustrative to see the differences among the standard deviation levels, Hawaiian Electric has not yet responded to stakeholder feedback regarding the decision to use three standard deviations.

Specifically, Ulupono raised concerns about the statistical rationale for using three standard deviations to set the regulating reserve requirement.⁹⁵ The Commission asked Hawaiian Electric to clarify why it chose to use three standard deviations over the "PSIP rule" or a percentile-based method with

⁹³See Grid Needs Assessment Methodology, Appendix D.

⁹⁴Grid Needs Assessment Methodology, Exhibit 1 at 176-181.

⁹⁵See Ulupono Comments, Attachment 1 at 3.

clear explanations of each of these approaches.⁹⁶ Hawaiian Electric explained that it intended to use the 3-sigma calculation "to require reserves that would cover most events and exclude the extreme outliers."⁹⁷ In so doing, Hawaiian Electric made clear its intent to use a conservative approach to set the level of reserve requirements. The Commission finds this acceptable for the first round of IGP. The Commission further directs Hawaiian Electric to conduct the additional analysis of the regulating reserve requirements recommended by Ulupono⁹⁸ to arrive at the desired percentile for calculating regulating reserves instead of the 3-sigma calculation and use this result to implement "the best combination of high reliability and low reserve requirements" in the next round of IGP.⁹⁹

Ulupono also raised concerns about situations when the regulating reserve criteria result in a reserve requirement that exceeds renewable output or load.¹⁰⁰ Ulupono recommended capping the regulating reserve requirements at the lesser of these two levels, but Hawaiian Electric did not directly respond to this

⁹⁶See Ulupono Comments, Attachment 1 at 3.

⁹⁷See Response to PUC-HECO-IR-40, part b at 2.

⁹⁸See Ulupono Comments, Attachment 1 at 11-12.

⁹⁹See Ulupono Comments, Attachment 1 at 3.

¹⁰⁰See Ulupono Comments, Attachment 1 at 12.

recommendation.¹⁰¹ The Commission sought clarity on this issue, to which Hawaiian Electric stated that the absence of a cap is “by design to account for events where renewable output rapidly declines and load increases or where renewable output rapidly increases and load declines.”¹⁰² The Commission accepts the current framework for determining regulating reserve requirements, but directs Hawaiian Electric to continue its review of this framework with stakeholders and the TAP to determine if there is a need to cap regulating reserve requirements in future rounds of IGP.

4.

Energy Efficiency Supply Curves

In response to the Commission’s directives to evaluate energy efficiency (“EE”) and other demand-side resources on a comparable basis with supply-side resources, Hawaiian Electric developed different EE forecasts, included in the Inputs and Assumptions filing, and EE supply curves, included in the Grid Needs Assessment Methodology. The Commission approved the EE load forecasts with modifications in Order No. 38253 and addresses the EE supply curves in this Order.

¹⁰¹See Ulupono Comments, Attachment 1 at 12.

¹⁰²Response to PUC-HECO-IR-41.

Attached as Exhibit 5 to the Grid Needs Assessment Methodology is the Applied Energy Group ("AEG") IGP Supply Curve Memo ("Memo").¹⁰³ The Memo describes the key aspects of the supply curve development support AEG provided, "including stakeholder engagement, measure bundling methodology, and summary supply curve information."¹⁰⁴ Additionally, Hawaiian Electric provided EE Supply Curve data in spreadsheets on its "Key Stakeholder Documents" webpage,¹⁰⁵ as well as in response to Commission IRs. No Party addressed the EE supply curves in its comments, including Hawaiian Electric.

AEG used the Market Potential Study ("MPS") to develop the achievable technical potential level of future EE, described as a subset of technical potential, accounting for likely customer adoption of energy efficiency measures without consideration of cost-effectiveness.¹⁰⁶ AEG then grouped EE measures from the achievable technical potential into resource bundles with similar characteristics that are selectable during

¹⁰³See Grid Needs Assessment Methodology, Exhibit 5.

¹⁰⁴Grid Needs Assessment Methodology, Exhibit 5 at 1.

¹⁰⁵See <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/key-stakeholder-documents>

¹⁰⁶See Grid Needs Assessment Methodology, Exhibit 5 at 2.

the capacity expansion step.¹⁰⁷ AEG used “relative contributions during peak periods and cost-effectiveness (as determined in the Statewide MPS)” as metrics to develop these bundles.¹⁰⁸ AEG first compared the impacts of each measure during the Companies’ average weekday evening peak hours of 6-8 p.m. to a flat load shape to determine a ratio of “peakiness,” and then grouped measures by the level of cost-effectiveness.¹⁰⁹ This methodology resulted in eight measure bundles, four “peak-focused” bundles and four “other” bundles, with associated levelized cost of conserved energy levels calculated as the savings-weighted average of the measures within the bundle.¹¹⁰

The Commission appreciates Hawaiian Electric’s work with AEG to develop the EE supply curves. There are many approaches and methodologies possible for developing EE supply curves, each with its own tradeoffs. It is necessary to make decisions on the approach taken to meet modeling constraints, to answer specific questions, and to appropriately balance time and resource use. The Commission believes that Hawaiian Electric’s current modeling approach for EE as a supply-side resource in this round of IGP

¹⁰⁷See Grid Needs Assessment Methodology, Exhibit 5 at 2.

¹⁰⁸Grid Needs Assessment Methodology, Exhibit 5 at 3.

¹⁰⁹Grid Needs Assessment Methodology, Exhibit 5 at 3.

¹¹⁰Grid Needs Assessment Methodology, Exhibit 5 at 3-4.

will serve as a good starting point and learning exercise to improve this modeling approach for all demand-side resources in future rounds of IGP.¹¹¹ The Commission acknowledges the effort to bundle measures based on their contribution to the peak period so the model can select resources that provide this particular system benefit and recognizes that eight is a sufficient number of bundles for the first round of IGP. The Commission therefore approves the Companies' EE supply curves, subject to any modifications that may be required based on the Commission's directions, below.

So that Hawaiian Electric can continue improving its EE modeling approach in future rounds of IGP, the Commission provides the following direction. Hawaiian Electric must revisit the bundle development to ensure that the "peak" bundles are composed of measures that produce savings during the system peak hours. In doing so, Hawaiian Electric must account for the system peak that is typically much longer than 6-8 p.m., i.e., from 5-10 p.m. The Commission is concerned that as currently designed, the bundles are not meeting the objective of determining the cost and timing performance needed from selected EE resources.¹¹² Hawaiian Electric must file an update reflecting any changes to

¹¹¹See Order No. 37730 at 49-51.

¹¹²See Response to PUC-HECO-IR-29d.ii.1.

the EE supply curves made in response to this directive with its updated Grid Needs Assessment Methodology by August 31, 2022.

The Commission believes AEG determined each measure's "peakiness" by comparing each measure's savings in the peak hours based on the relevant end-uses' consumptive load shapes (weighted by 2045 average technical potential) to a flat shape (i.e., 1/8760).¹¹³ This methodology may capture the measures' peak impacts, but it was not clearly explained or traceable to any provided materials. The effect of comparing peak savings to a flat shape is not clear, and based on the bundle results, the Commission is not convinced that this methodology appropriately captures each measure's system coincident peak impacts.

For example, the Commission agrees that, when averaged across all four "peak" bundles, the impacts in the "peak" bundles during the 6-8 p.m. peak period are higher than the "other" bundles.¹¹⁴ However, the accompanying graphs show that this is not the case when the bundles are considered individually.¹¹⁵ The graph of "Peak A" bundle impacts shows that the percent of maximum savings drops from nearly 100% to around 60% in the 6-8 p.m. period, and further declines to about 40% in the following

¹¹³See Response to PUC-HECO-IR-35.

¹¹⁴See Response to PUC-HECO-IR-29, part e.i., Figure 2.

¹¹⁵See Response to PUC-HECO-IR-29, part e., graphs at 3.

two hours. Conversely, the graph of "Other A" bundle impacts shows steady impacts around 95% throughout the 6-8 p.m. period and only fall to 80% in the following two hours. This is important because these two bundles include almost three quarters of all savings across all bundles.

It is also not clear whether the peak ratio methodology produces peak bundles in which (1) the majority of savings are coincident with system peak or (2) the measure's maximum savings occur during peak hours. For example, a refrigerator could produce its maximum savings during peak hours, but also create savings throughout the day. While both approaches reduce peak demand, the measure composition of the bundles produce different overall bundle shapes. The model will select the efficiency bundles based on if they align with the system needs, thus the methodology used to create the bundles has significant impact on if efficiency is selected. Clear explanation of the bundling process and rationale for using it must be provided. Hawaiian Electric must clearly describe this distinction in the bundling process, and its reasons for choosing this approach, in its finalized Grid Needs Assessment Methodology.

For future rounds of IGP, the Commission directs Hawaiian Electric to solicit feedback from stakeholders early in the process to create energy efficiency inputs for IGP including:

- (1) application of the MPS to determine the technical achievable

potential, cost-effectiveness of measures and bundles, and transparency and consistency with the load forecast especially with respect to baseline efficiency levels, impacts from known codes and standards, impact on market potential (quantity and type) across a range of economic load growth forecasts, and different availability of retrofit versus lost-opportunity efficiency measures; (2) generally, the proposed approach to bundling measures (e.g., based on contribution to peak and cost-effectiveness, versus by end-use, building type, solely on cost-effectiveness, etc.); (3) whether measures should be grouped into more granular cost-effectiveness buckets, particularly around the system avoided cost level; (4) treatment of re-acquisition of measures at the end of their useful lives; and (5) treatment of load controllability and the approach of using the same hourly savings shape by bundle for a single year then scaled by the annual cumulative capacity for future years.

Soliciting feedback from stakeholders on the methodology used to bundle measures before providing a memo and draft bundles could promote transparency and understanding of the approaches Hawaiian Electric uses to answer questions. For example, creating bundles in more granular cost-effectiveness buckets around the system avoided cost level would give the model more meaningful EE bundle choices compared to having very large bundles of very high cost measures that are unlikely to be selected by

the model. Stakeholders could provide input on how best to balance different bundling techniques with concerns about model run time. The Commission expects that results from this round of IGP will inform and improve future load forecasting and modeling approaches.

5.

Solution Evaluation Modeling & Competitive Procurement

The Commission recognizes that Hawaiian Electric's Solution Evaluation Methodology is "an evolving area and the Company will continue to work with the TAP and stakeholders, as well as Independent Observers . . . to inform how solutions are evaluated."¹¹⁶ The Commission appreciates Hawaiian Electric's engagement with stakeholders on this issue, and the adjustments and clarifications it made in response to stakeholders.

While recognizing that important elements of the methodology may not yet be finalized, the Commission believes Hawaiian Electric's latest description of the methodology is too often unclear and ambiguous. Hawaiian Electric must provide a clear description of the proposed methods for evaluating potential solutions to the grid needs identified to promote understanding and robust competition among potential solution providers. It is

¹¹⁶Grid Needs Assessment Methodology, Exhibit 1 at 82.

equally important to provide the Commission, stakeholders, and the public with a clear understanding of the opportunities for their involvement in the development of procurement mechanisms. In particular, Section 3.7.4 "Solution Sourcing" does not provide a clear or well-defined description of the solution sourcing step within the grid needs assessment modeling process.

Hawaiian Electric divides its methodologies into three channels: (1) competitive procurements; (2) programs; and (3) "programs that seek solutions through competitive procurements (hybrid)."¹¹⁷ There are no major flaws in the methodologies as conceptually described, but the lack of clarity and detail describing each prevents a conclusion that the methods are appropriate or acceptable. While the Commission understands that many details will be developed in individual programmatic and solution sourcing proceedings, the Commission offers the following guidance related to additional detail needed on how IGP results will inform solution sourcing.

Competitive procurements. Hawaiian Electric's description is generally consistent with its proposed changes to the Competitive Bidding Framework. However, Hawaiian Electric is silent on how it will use IGP results to help determine the priorities or weights for evaluating the relative contributions of

¹¹⁷See Grid Needs Assessment Methodology, Exhibit 1 at 82-85.

different grid services, such as energy and capacity, provided by proposed system resources. Hawaiian Electric only states that it could complete a levelized price calculation for each project based on the proposed energy output and/or capacity using either fixed and variable pricing depending on the technology being proposed.¹¹⁸

Program evaluations. Hawaiian Electric describes its approach for valuing DERs by determining the cost of the system with assumed DERs frozen at current levels and then comparing this to the cost of the system with a forecasted increase in DER levels, and notes that the difference in cost could then be interpreted as the value of the forecasted increase in DER levels.¹¹⁹ The Commission agrees that this may serve as a reasonable starting point, but Hawaiian Electric's description does not provide any additional detail on how findings from the IGP process will interact with outcomes in the DER docket or will be used to inform the target levels of DER procurements or the amounts of System Resources sought via competitive procurements.

Hybrid approach. Hawaiian Electric also proposes programs that seek solutions through competitive procurement citing the CBRE Phase 2 RFP and providing an illustrative example

¹¹⁸See Grid Needs Assessment Methodology, Exhibit 1 at 85.

¹¹⁹See Grid Needs Assessment Methodology, Exhibit 1 at 83.

that it describes in the Grid Needs Assessment Methodology.¹²⁰ The illustrative example includes an initial comparison of program solutions bid into the RFP by using annual program cost and "net nameplate capacity" to compare programs based on their capacity prices.¹²¹ Using this comparison to establish a smaller priority list of bids, the next step "could consist of an assessment of combinations of proposals from the priority list" which could be compared against "a simplified proxy of benefits and value of proposals of the program portfolio" determined with a capacity expansion model.¹²² Again, while presenting a starting point, this description does not address the source of costs that would be used in the capacity expansion model.

In finalizing its Grid Needs Assessment Methodology, Hawaiian Electric must briefly explain any references to other dockets within IGP filings for the benefit of the docket record and the parties. In this example, a potential procurement participant should not be expected to locate and be sufficiently

¹²⁰See Grid Needs Assessment Methodology, Exhibit 1 at 83-84. The Commission notes that Hawaiian Electric erroneously references Docket No. 2019-0323. Docket No. 2019-0323 is the Distributed Energy Resource docket. The docket containing CBRE filings, such as the CBRE Phase 2 RFP, is Docket No. 2015-0389.

¹²¹Grid Needs Assessment Methodology, Exhibit 1 at 84.

¹²²Grid Needs Assessment Methodology, Exhibit 1 at 84.

familiar with an unrelated RFP in a separate docket to understand an example. In refining these explanations, Hawaiian Electric might also identify potential inconsistencies and clarify its rationale for proceeding with this approach.

As noted above, the Commission recognizes and appreciates Hawaiian Electric's ongoing engagement with stakeholders to develop its Solution Evaluation Methodology. Hawaiian Electric should continue this engagement to provide a clearer explanation of its proposed Solution Evaluation Methodology. In particular, Hawaiian Electric must clarify the relationships, if any, between the three channels (competitive procurements, program evaluations, and hybrid). For example, Hawaiian Electric must make clear if it intends to make contemporaneous comparisons of bids from aggregators to provide grid services from DERs with bids for System Resources received in a competitive procurement, or if it will consider bids for System Resources and programs considered together in portfolios, or if cost information from System Resource bids will be used to establish the proxy of benefits against which program bids are evaluated.

The Commission will further review the Solution Evaluation Methodology when Hawaiian Electric: (1) issues any RFPs; (2) proposes any new programs; and (3) when it evaluates

solutions, as illustrated in the IGP Workplan Update.¹²³ Hawaiian Electric shall incorporate this guidance into its finalized Grid Needs Assessment Methodology.

6.

Transmission REZ Study

Hawaiian Electric developed the REZ concept as a part of the Transmission Planning analyses performed for the Grid Needs Assessment Methodology phase. Hawaiian Electric selected geographic areas with potential for renewable energy development and estimated the costs of transmission infrastructure required to interconnect projects grouped in the REZ. The Commission appreciates Hawaiian Electric's clarity around certain inputs for the REZ analysis¹²⁴ (e.g., NREL's Potential Study for Solar and Wind Resources, Hawaiian Electric's Transmission Planning Criteria, etc.), the study's application to the RESOLVE modeling step,¹²⁵ and the use of the results in the NWA evaluation.¹²⁶

¹²³See Letter From: M. Asano To: Commission Re: "Docket No. 2018-0165, Instituting a Proceeding to Investigate Integrated Grid Planning, Hawaiian Electric Updated Timeline and Stakeholder Engagement Plan," filed on June 18, 2021, Attachment 2.

¹²⁴See Grid Needs Assessment Methodology, Exhibit 1 at 57-58, Table 3-1.

¹²⁵See Grid Needs Assessment Methodology, Exhibit 1 at 57-58.

¹²⁶See Grid Needs Assessment Methodology, Exhibit 1 at 57.

After filing the Grid Needs Assessment Methodology, Hawaiian Electric updated its incorporation of the REZ Study results in the RESOLVE model to include a cost adder for developing PV on slopes greater than 15%, noting that to manage the number of available resource options in RESOLVE, the REZ study groups will further be grouped by resources that had similar REZ enablement costs.¹²⁷

The Commission recognizes the need to incorporate transmission related costs associated with new resources into the capacity expansion model; however, the Commission is concerned about the accuracy of these costs and implications on the model outcomes. While the Commission acknowledges the additional work that Hawaiian Electric performed to incorporate incremental costs for the REZ group costs,¹²⁸ the Commission remains concerned about the underlying cost assumptions.

To address these concerns, the Commission directs Hawaiian Electric to test the sensitivity of the transmission costs inputs in RESOLVE resulting from the REZ study. For example, one approach could be running RESOLVE with and without the REZ

¹²⁷See Letter From: M. Asano To: Commission Re: "Docket No. 2018-0165, Instituting a Proceeding to Investigate Integrated Grid Planning, Supplemental Response to Order No. 38253 Approving Inputs and Assumptions with Modifications," filed on March 31, 2022, at 9.

¹²⁸See Grid Needs Assessment Methodology, Exhibit 2 at 34.

study costs and evaluating the impact of the costs on the resulting resource plan. With a better understanding of the impact of the REZ results, the Commission and stakeholders will be able to evaluate the cost sensitivity of the RESOLVE model to transmission costs in order to assess the need for future refinements of the underlying cost assumptions and finer increments for the incremental cost estimates.

Further improvements that Hawaiian Electric must make to future iterations of the REZ study include: (1) following the TAP's recommendations to incorporate behind-the-meter DERs;¹²⁹ (2) creating stepwise supply curves for each group;¹³⁰ (3) incorporating non-Transmission alternatives;¹³¹ and (4) conducting additional transmission studies.¹³² The Commission also directs Hawaiian Electric to consider the TAP's recommendation to use a chronological modeling tool, such as PLEXOS, to perform the dispatch analysis necessary to evaluate real-life scenarios and estimate transmission-related costs more accurately in future iterations of the REZ study.¹³³

¹²⁹See Grid Needs Assessment Methodology, Exhibit 2 at 87.

¹³⁰See Grid Needs Assessment Methodology, Exhibit 2 at 85.

¹³¹See Grid Needs Assessment Methodology, Exhibit 2 at 86.

¹³²See Grid Needs Assessment Methodology, Exhibit 2 at 83.

¹³³See Grid Needs Assessment Methodology, Exhibit 2 at 84.

Many stakeholders commented that the REZ study should be constrained by community acceptance. Hawaiian Electric responded that it will seek community feedback on the REZ groups, but has not considered environmental or community acceptance constraints at this stage and will obtain stakeholder feedback as a next step.¹³⁴

Community acceptance is an essential component of REZ feasibility. Without it, the REZ concept will be unworkable. Hawaiian Electric must therefore propose a community engagement plan for REZ development. This plan should clearly define how results from community engagement will inform REZ constraints and how these constraints will modify the results of the study. This plan will require Hawaiian Electric to clearly present technical information in a way that all stakeholders can easily comprehend, as discussed throughout this order. The Commission will monitor this process as it progresses before approving the results.

¹³⁴See Grid Needs Assessment Methodology, Exhibit 2 at 82.

Distribution DER Hosting Capacity Grid Needs

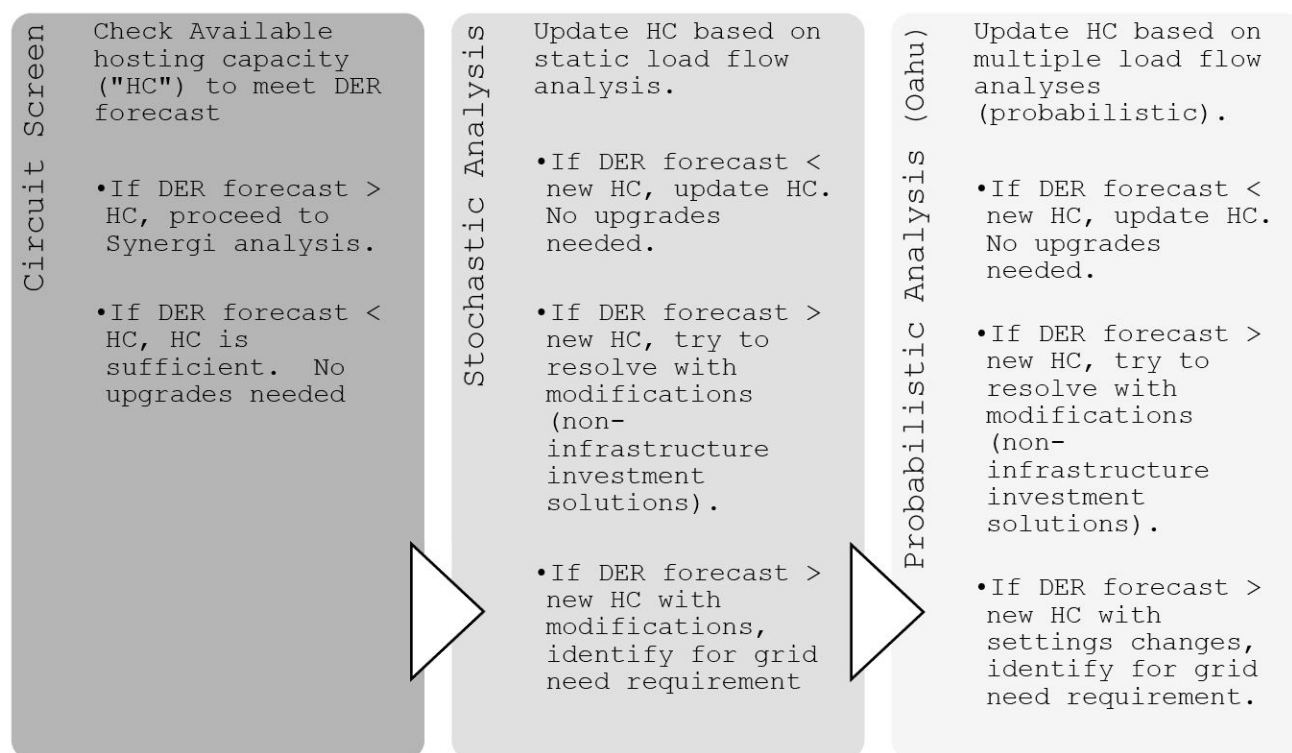
As part of the Distribution Planning Process, the "Distribution DER Hosting Capacity Grid Needs" identifies circuits with hosting capacity violations in the next five years under the low, base, and high DER forecasts and identifies solution options to mitigate those violations.¹³⁵ Hawaiian Electric described circuit-level hosting capacity as "the maximum aggregate [kilowatt ("kW")] amount of small scale DERs a circuit can host before any thermal or voltage violations occur."¹³⁶ Hawaiian Electric outlined four steps it uses to identify circuits with hosting capacity violations through 2025: (1) determine the annual anticipated DER (kW) by circuit; (2) screen circuits for analysis; (3) perform substation transformer and circuit-level hosting capacity analysis; and (4) identify grid needs and solution options.¹³⁷ The hosting capacity analyses use Synergi's built-in PV Grow function for the stochastic analysis and a methodology developed in collaboration with Electric Power Research Institute

¹³⁵Grid Needs Assessment Methodology, Exhibit 4 at 6.

¹³⁶Grid Needs Assessment Methodology, Exhibit 4 at 10.

¹³⁷See Grid Needs Assessment Methodology, Exhibit 4 at 10.

("EPRI") for the probabilistic analysis.¹³⁸ The following figure summarizes this process.¹³⁹



Further development of the hosting capacity analysis in the Distribution Planning Process will aid in determining and mitigating future hosting capacity violations. This iterative process for determining hosting capacity based on in-depth stochastic and probabilistic analyses will allow Hawaiian Electric to resolve grid deficiencies more holistically with non-infrastructure investment solutions. The process will also

¹³⁸See Grid Needs Assessment Methodology, Exhibit 4 at 20-21.

¹³⁹Figure adapted from Grid Needs Assessment Methodology, Exhibit 4 at 18, Figure 6.

enable DER growth across Hawaiian Electric's service territories as the State and Hawaiian Electric rapidly pursue decarbonization and resilience goals. Therefore, the Commission approves this methodology for this round of IGP. The Commission notes that the approval of this methodology as part of this Review Point is for use within the IGP process and should not be construed as approval for general use in other dockets, as Hawaiian Electric is updating its existing hosting capacity methodology to account for all hours in its Distribution Planning Methodology.¹⁴⁰

In the final step to identify grid needs and solution options, Hawaiian Electric selects a traditional solution for each circuit violation. Hawaiian Electric presents the assessment for each of the three forecasts in tables which provide the Violation Type, Operating Date, Traditional Solution, and Cost Estimate for each circuit violation.¹⁴¹ The Commission sought clarity regarding which metrics are applied to identify grid needs and solution options and how results are used in the actual maintenance of the grid. Hawaiian Electric explained that solution options are determined using "a least-cost approach"¹⁴²

¹⁴⁰See Grid Needs Assessment Methodology, Exhibit 1 at 266-267.

¹⁴¹See Grid Needs Assessment Methodology, Exhibit 4 at 31-46.

¹⁴²Response to PUC-HECO-IR-31 at 1.

that identifies solutions scheduled for completion "to coincide with the date when . . . [the] violation is forecast,"¹⁴³ and that Hawaiian Electric is "commencing with low implementation cost solutions for the circuits that already have violations or [are] forecast[ed] to have violations in 2022."¹⁴⁴

For Oahu, Hawaiian Electric derives forecasted DER growth by feeder using LoadSEER.¹⁴⁵ Hawaiian Electric notes that "battery energy storage capacity is not included in the aggregated DER values as it is assumed that energy storage systems will not export during the day."¹⁴⁶ The Commission sought clarity in

¹⁴³Response to PUC-HECO-IR-30 at 1.

¹⁴⁴Response to PUC-HECO-IR-32 at 1.

¹⁴⁵See Grid Needs Assessment Methodology, Exhibit 4 at 12. Hawaiian Electric indicates that it plans to use LoadSEER for the islands of Maui and Hawaii Island in the middle of 2022. Hawaiian Electric describes LoadSEER as an "electric load forecasting software that creates circuit-level forecasts by combining historical SCADA and weather data along with forecasted new load, DER, EV, and EE spatially allocated throughout the system. LoadSEER spatially allocates these layers at the distribution level through an agent-based simulation that determines the likelihood (i.e., propensity score) that each of these types will be adopted at each service point. This process refines the system level forecast and provides location information such as customer consumption, historical DER adoption, census tract data, among others, with circuit-level forecasts. LoadSEER constrains the total amount that gets allocated for each of these layers by an incremental system level limit for each layer. The system level constraint is based on the corporate DER forecast." Grid Needs Assessment Methodology, Exhibit 4 at 13.

¹⁴⁶Grid Needs Assessment Methodology, Exhibit 4 at 12.

PUC-HECO-IR-34 regarding whether an alternative treatment of battery energy storage capacity on DER export profiles could affect the hosting capacity results. Hawaiian Electric stated that modeling energy storage capacity to export coincidentally with distributed solar may:

result in lower remaining hosting capacity on circuits, resulting in excessive grid needs identified to accommodate additional DER at the circuit level. Conversely, if all planned DER was modeled with energy storage to mitigate export to the distribution system, distribution level hosting capacity upgrades could be avoided; however, this is not a realistic assumption based on the various DER export programs available.¹⁴⁷

The Commission appreciates this explanation. Although the Commission will not require any modifications or clarifications to this methodology for use in this round of IGP, the Commission encourages Hawaiian Electric to consider whether this is the appropriate treatment for battery energy storage capacity in future iterations of IGP. The proportion of DER installations paired with battery energy storage will likely increase as a significant portion of new DER installations include battery energy storage¹⁴⁸ and several programs offered by

¹⁴⁷Response to PUC-HECO-IR-34 at 2-3.

¹⁴⁸See Hawaiian Electric's 2021-2022 Sustainability Report at 3, available at <https://view.hawaiianelectric.com/2021-2022-sustainability-report/page/2-3>, which indicates that 91% of new rooftop solar is installed with battery storage.

Hawaiian Electric and DER aggregators (e.g., Battery Bonus and the Grid Service Purchase Agreements) incentivize paired storage. As this proportion increases, Hawaiian Electric should consider whether its hosting capacity methodology should evolve in response. For example, if Hawaiian Electric can efficiently use battery energy storage capacity to mitigate hosting capacity violations, it should.

8.

Stakeholder Engagement

The Commission appreciates Hawaiian Electric's efforts to engage stakeholders during the IGP process. During revisions to the Inputs and Assumptions, Hawaiian Electric created the STWG and held 11 meetings in 2021.¹⁴⁹ Hawaiian Electric also included several sections in this Review Point detailing stakeholder feedback on specific exhibits.¹⁵⁰ It is vital to continue engaging stakeholders during the grid needs assessment process following this Order to keep everyone apprised of progress and to allow

¹⁴⁹See Hawaiian Electric's IGP website <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-engagement/working-groups/stakeholder-technical-documents> for links to presentation slides, meeting summary notes, and related documents.

¹⁵⁰See Grid Needs Assessment Methodology, Exhibit 1 at 24-41, Exhibit 2, Appendix C at 88-92, Exhibit 3, Appendix B at 60-61, and Exhibit 4, Appendix B at 50-54.

meaningful opportunities for input. The Commission agrees with Hawaiian Electric that, “[a]dvancing the [IGP] process to the next stage will facilitate a more robust discussion by stakeholders and support Commission decision making in various current and future proceedings, helping to achieve key decarbonization and resilience goals.”¹⁵¹ To this end, Hawaiian Electric must hold regular check-ins with stakeholders throughout the grid needs assessment process using the STWG.

The County recommends adding “an executive summary section in each exhibit of the methodology review,” in part to enable stakeholders without technical engineering backgrounds to better understand the IGP process.¹⁵² Hawaiian Electric notes that each appendix includes similar summary sections and that while they “are willing to work with stakeholders to ensure that appropriate summary sections are available for future such filings,” that this “should not be a requirement to progress the acceptance of the IGP Grid Needs Assessment Methodology Review Point.”¹⁵³

The Commission will not require such an executive summary for this Review Point. However, Hawaiian Electric must

¹⁵¹See Hawaiian Electric Reply Comments at 5.

¹⁵²County Comments at 4.

¹⁵³See Hawaiian Electric Reply Comments at 14-15.

continue improving how it explains analyses within each Review Point, especially the purpose and use of analyses. The easier it is for stakeholders to understand individual steps of the IGP process and how those steps work together toward Hawaiian Electric's long-term goals, the more meaningful input those stakeholders can provide to the IGP process. Clear communication will be especially important for community engagement around the REZ process.

9.

TAP Guidance

The TAP provided guidance on Hawaiian Electric's analyses and methods throughout the development phases and review points of the IGP process. As attachments to the TAP's review of the grid needs assessment filings, the TAP provided four standalone reviews with feedback on the Transmission Planning Criteria, the System Security Study, the Distribution Planning Methodology, the Non-Wires Opportunity Evaluation Methodology, and the REZ study.¹⁵⁴ The Commission appreciates the organization of the TAP's reviews which categorize their feedback into three categories: (1) informational - no action needed; (2) suggest revising study

¹⁵⁴See Grid Needs Assessment Methodology Exhibit 1, Appendix K at 316-327.

before finalizing; and (3) consider feedback for future portions of the IGP process.¹⁵⁵ Additionally, Hawaiian Electric provided helpful annotations throughout these feedback documents for the TAP suggestions for near-term revisions by indicating the section numbers of the study where the revision is incorporated.¹⁵⁶

There are several important issues that the TAP categorized under considerations for future portions of the IGP process. For example, the TAP provided follow up remarks including suggestions for considering non-transmission alternatives and the land costs for significant transmission upgrades in the context of the REZ study results.¹⁵⁷ If not addressed explicitly in the preceding sections, the Commission directs Hawaiian Electric to clearly communicate to the Commission and stakeholders when the TAP's recommendations for future IGP processes will be implemented. The Commission also directs Hawaiian Electric to file future written recommendations and advice from the TAP, as they are received, in this docket. This continued consultation

¹⁵⁵See Grid Needs Assessment Methodology, Exhibit 1 at 330, 334, 337, 340 and Exhibit 2, at 82.

¹⁵⁶Hawaiian Electric used a green check mark with a section number to denote where it incorporated TAP suggestions. See e.g., Grid Needs Assessment Methodology, Exhibit 2 at 84.

¹⁵⁷See Grid Needs Assessment Methodology, Exhibit 2 at 86.

with and learning from the TAP throughout the modeling process will be critical to IGP's success.

The Commission also notes that the TAP has provided additional feedback documents since Hawaiian Electric filed the Grid Needs Assessment Methodology, addressing topics including Resource Adequacy and Modeling, Under Frequency Load Shed Study Plans, as well as clarifications from earlier feedback on the System Stability studies and the Distribution Planning Methodology.¹⁵⁸ Hawaiian Electric also uploaded details and presentation slides from a recent TAP meeting held on May 4 and 5, 2022.¹⁵⁹ Although these materials were not submitted with the Grid Needs Assessment Methodology, the Commission directs Hawaiian Electric to file these documents in this docket and to continue to provide annotations for where it incorporates the TAP's feedback and how and when it will implement TAP recommendations for future IGP iterations.

¹⁵⁸See Technical Advisory Panel webpage documents from January 21, 2022, February 25, 2022, March 10, 2022, March 11, 2022, and April 28, 2022, available at <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/technical-advisory-panel>.

¹⁵⁹See Technical Advisory Panel webpage documents from May 4-5, 2022 available at <https://www.hawaiianelectric.com/clean-energy-hawaii/integrated-grid-planning/stakeholder-and-community-engagement/technical-advisory-panel>.

D.

Fossil Fuel Retirement Plans

In Docket No. 2018-0088, the Commission directed Hawaiian Electric to develop a Fossil Fuel Retirement Report, with bi-annual updates.¹⁶⁰ To facilitate further IGP discussions about Hawaiian Electric's plans for retiring its fossil fuel generators, Hawaiian Electric shall file copies of the Fossil Fuel Retirement Report in this docket.

E.

Next Steps

Hawaiian Electric shall file a finalized Grid Needs Assessment Methodology and Solution Evaluation Methodology, consistent with the directives and guidance in this Order by August 31, 2022. Hawaiian Electric's finalized Grid Needs Assessment Methodology and Solution Evaluation Methodology shall be approved automatically ten days after they are filed, unless the Commission orders otherwise. Hawaiian Electric shall collaborate with the TAP and the Parties to develop a workplan that explains how it will develop its ELCC-based resource adequacy criteria, and file that workplan with the Commission by August 31, 2022.

¹⁶⁰See Docket No. 2018-0088, Decision and Order No. 38429, filed on June 17, 2022, at 21-28.

IV.

ORDERS

THE COMMISSION ORDERS:

1. Hawaiian Electric shall file its finalized Grid Needs Assessment Methodology, consistent with the directives and guidance in this Order by August 31, 2022.

2. Hawaiian Electric shall create a workplan with the TAP and the Parties explaining how it will develop its ELCC-based resource adequacy criteria, and file that workplan by August 31, 2022.

3. Hawaiian Electric's finalized Grid Needs Assessment Methodology shall be approved automatically ten days after it is filed, unless the Commission orders otherwise.

DONE at Honolulu, Hawaii JUNE 30, 2022.

PUBLIC UTILITIES COMMISSION
OF THE STATE OF HAWAII

By James P. Griffin, Chair By Jennifer M. Potter, Commissioner

APPROVED AS TO FORM:

Mike S. Wallerstein
Mike S. Wallerstein
Commission Counsel

By Leodoloff R. Asuncion, Jr., Commissioner

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CERTIFICATE OF SERVICE

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